UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MEMORANDUM

DEC 8 1992

OFFICE OF
PESTICIDES AND TOXIC
SUBSTANCES

SUBJECT: Review of Benomyl 50W 6(a)(2) Literature

FROM: Anthony F. Maciorowski, Chief
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TO: Kate Bouve, 6(a)(2) Coordinator
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The Florida Department of Agriculture and Consumer Services, Division of Inspection in Tallahassee, FL has submitted a literature review to the Registration Division. The package was determined to contain 6(a)(2) adverse effects data (phytotoxicity) for the fungicide benomyl (Benlate WP). Most of the studies were conducted in the 1960's and 1970's using the 50% wettable powder formulation of benomyl. The Ecological Effects Branch has received no reports of phytotoxicity to treated or non-target plants from the registered use of Benlate 50% wettable powder. It is our understanding that all alleged phytotoxicity incidents investigated by DuPont Chemical Company and the Florida Department of Agriculture and Consumer Services have been associated with the use of the 2 lb. package of Benlate dry flowable (DF) formulation.

The following plant growth related studies for benomyl were reviewed by the Ecological Effects Branch for adverse effects information:

1.) Klingensmith, M.J. 1961. The Effect Of Certain Benzazole Compounds On Plant Growth And Development. American Journal Of Botany. Vol. 48 (Jan. 1961):40-46.

2.) Reyes, A. A. 1975. Phytotoxicity Of Benomyl To Crucifers. Phytopathology. Vol. 65 (May, 1975):535-539.

3.) Schreiber, L.R. and W.K. Hock. 1975. Effects Of Benomyl And Thiabendazole On Growth Of Several Plant Species. J. Amer. Soc. Hort. Sci. Vol. 100 (3):309-313.

4.) Roberts, B.R., W.K. Hock, and L.R. Schreiber. 1973. The Effect Of Benomyl On The Growth Of American Elm Seedlings. Phytopathology. Vol. 63 (Jan.):85-87.

5.) Baude, F.J., H.L. Pease, and R.F. Holt. 1974. Fate Of Benomyl On Field Soil And Turf. J. Agr. Food Chem. Vol. 22(3):413-418.

6.) Delp, C.J. and H.L. Klopping. 1968. Performance Attributes Of A New Fungicide And Mite Ovicide Candidate. Plant Disease Reporter. Vol. 52(2):95-99.

7.) Beckerson, D.W. and D.P. Ormrod. 1986. Investigating The Cytokininlike Properties Of Benomyl: Laboratory Growth Studies. Plant Disease. (Jan. 1986):55-57.

8.) DeBertoldi, M., M. Giovannetti, M. Griselli, and A. Rambelli. 1977. Effects Of Soil Applications Of Benomyl And Captan On The Growth Of Onions And The Occurrence Of Endophytic Mycorrhizas And Rhizosphere Microbes. Annals Of Applied Botany. Vol. 86(1):111-115.

9.) Robinson, P.W. and C.F. Hodges. 1972. Effect Of Benomyl On Eradication Of Ustilago striiformis from Agrostis palustris And On Plant Growth. Phytopathology. Vol. 62(May 1972):533-535.

10.) Shields, R., S.J. Robinson, and P.A. Anslow. 1984. Use Of Fungicides In Plant Tissue Culture. Plant Cell Reports. Vol. 3:33-36.

11.) Wensley, R.N. 1972. Effects Of Benomyl And Two Related Systemic Fungicides On Growth Of Fusarium Wilt-Susceptible And Resistant Muskmelon. Can. J. Plant Sci. Vol.52:775-779.

12.) Yang, H-J. 1976. Effect Of Benomyl On Asparagus officinalis L. Shoot and Root Development In Culture Media. Hortscience. Vol. 11(5):473-474.

Also included were 2 kinetics studies for benlate fungicide. The following 2 studies were reviewed by Kevin Poff of Environmental Fate And Groundwater Branch (EFGWB).

1.) Singh, R.P. and I.D. Brindle. 1990. Kinetic Study of the Decomposition of Methyl [1-(Butylcarbamoyl)-1H-binzimidazol-2-yl] carbamate (Benomyl) to Methyl 1H-Benzimidazol-2-yl-carbamate (MBC). J. Agric. Food Chem. Vol.38(8):1758-1762.

2.) Chiba, M. and E.A. Cherniak. 1978. Kinetic Study of Reversible Conversion of Methyl 1-(Butylcarbamoyl)-2-benzimidazolecarbamate (MBC) and n-Butyl Isocyanate (BIC) in Organic Solvents. J. Agric. Food Chem. Vol. 26(3): 573-576.

CONCLUSIONS

There were no reports of adverse human health effects associated with benomyl use in any of the 12 articles reviewed. Article numbers 1.) and 8.) did not provide a description of the benomyl formulation used in the study. Of the remaining articles, the following contained some target area phytotoxicity information that was associated with Benlate 50% wettable powder: 2.), 3.), 4.), 6.), 7.), and 11.). Based on the limited information regarding test methods and procedures in these articles, it is doubtful that these studies would meet current good laboratory practices. Therefore, the EEB has not conducted formal data evaluation records (DER's) to validate or invalidate the studies.

In general, articles 2.), 3.), 4.), 6.), 7.), and 11.) do not contain any non-target phytotoxicity information. They are laboratory studies conducted to determine subtle growth effects of chemicals on treated plants. Based on information in these articles, Benomyl 50% WP has demonstrated phytotoxicity to selective crop cultivars such as cabbages, cauliflower, muskmelon, pea, squash, tomato, tobacco, onions, lettuce, sweet corn, mushrooms, potato tubers, barley, cucumber, chrysanthemum, American elm, sycamore, and buckthorn. The phytotoxic effects occurred when these plants were emerging through treated soil or were very young and transplanted into treated soil. No phytotoxicity occurred from applications of Benlate 50% WP to plant foliage.

The severity of the phytotoxic effects were dependent on:

1.) the sensitivity of the plant to Benlate 50% WP (of the cole crops, cabbage seedling cultivar Eastern Ballhead and cauliflower cultivars Clou and Idol were very sensitive to Benlate 50% WP whereas seedlings of cabbage cultivars Red Rock, Early Greenball, King Cole, and Chieftain Savoy; broccoli cultivars Spartan Early and Green Comet; and brussels sprouts cultivars Jade Cross and Catskill were not injured).

2.) the stage of growth of the plant when exposed to the chemical (sensitive cabbage and cauliflower cultivars were severely stunted when exposed at the seedling stage of growth but were not affected when Benlate was applied at the 8 week old stage. Sensitive American elm, sycamore, and buckthorn species were stunted at the seedling stage of growth but were unaffected when exposed at the 3 and 10 month stages of growth),

3.) the method of chemical application (foliar, root drench, soil amendment; foliar applications were not phytotoxic to turf, apples, cherries, peaches, grapes, blueberries, citrus, squash, beans, tomato, celery, sugarbeets, or roses; soil applications at the seedling stage were phytotoxic to some species in some tests due to rapid uptake of chemical by the seedling and systemic translocation via xylem to the leaf tissues),

4.) the concentration of Benlate 50% WP applied (a root drench caused injury to seedling stage cucumber, tomato, lettuce, and sweet corn at rates of 3,571 lb. ai/acre and above which greatly exceeds field crop use rates; in some studies, when plants were removed and transplanted into untreated soil, the plants recovered from the phytotoxicity and resumed normal growth),

5.) the presence or absence of certain surfactants (in one study the use of GAFAC RA-600 alone or with Benlate 50% WP resulted in increased phytotoxicity to cole crops. The use of Tween 20 surfactant did not cause phytotoxicity),

6.) the type of rooting media as related to soil texture and organic matter content (in a high clay soil, 29% of American elm seedlings emerged in Benlate treated pots vs 50% in untreated pots; in a high sand content soil, 19% of Amer. elm seedlings emerged from Benlate treated pots vs 37% in the control; and in typical potting soil with high organic matter content [typically used in greenhouses and nurseries], 24% of the Amer. elm seedlings emerged in Benlate treated pots vs 27% emergence in control pots).

When phytotoxicity occurred, it was described as chlorosis of the leaf tip and center; newly developed leaves showed phytotoxic symptoms; yellowing occurred at the bo rders of affected areas of the leaf along veins; loss of turgidity resulted in wilting; leaves became whitish, brittle and dried which can lead to plant death; the dead leaves hang from green stems. In some cases, the seedling plants were stunted but appeared normal.

To date, the EEB has received no reports of adverse phytotoxic effects resulting from the use of Benlate 50 WP by growers. Using cabbage as an example, the registrant has labeled around potential phytotoxicity problems by only allowing foliar sprays at 14 day intervals at reduced rates. Most greenhouse and nursery growers use high organic matter, low clay soil mixes which would tend to diminish the potential for plant phytotoxicity.

The EEB cannot conclude from these data that the active ingredient benlate is the sole toxicant. Fifty percent of the WP formulation tested contains inerts which may or may not be independently phytotoxic. Also, the inerts contained in the Benlate 50 WP formulation may have changed since the 1960's and 1970's when these tests were conducted.

The DuPont Chemical Company has recently completed a number of greenhouse and ornamental plant studies in which the wettable powder and dry flowable formulations were compared for phytotoxic effects. The Florida Department of Agriculture and Consumer Services might consider a review of this more recent research as well.

Please contact Richard Petrie of this branch if you have any questions regarding this review (CM-2, Room 1030-L, 305-7358).